

American National Standard for Switchgear and Transformers—Pad- Mounted Equipment—Enclosure Integrity for Coastal Environments

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American National Standard for Switchgear and Transformers—Pad- Mounted Equipment—Enclosure Integrity for Coastal Environments

1. Scope and purpose

1.1 Scope

This standard covers conformance tests and requirements for the integrity of above grade pad-mounted enclosures intended for installation in coastal environments. Other performance requirements may be needed to provide long field life in other contaminated environments. These enclosures contain apparatus energized in excess of 600 volts that may be exposed to the public including, but not limited to, the following types of equipments enclosures:

- Pad-mounted capacitors or inductors;
- Pad-mounted distribution transformers;
- Pad-mounted junction enclosures;
- Pad-mounted metering equipment;
- Pad-mounted switchgear.

This standard does not cover installations that are under the exclusive control of electric utilities and that are located in such a manner that access to the equipment is controlled exclusively by the utility.

1.2 Purpose

The purpose of this standard is to describe the requirements for a comprehensive integrity system for pad-mounted enclosures providing long field life with minimum maintenance and positively safety features.

2. Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI C57.12.28-1988, *Switchgear and transformers – Pad-mounted equipment – Enclosure integrity*

ASTM B117-85 E1, *Standard method of salt spray (fog) testing*¹⁾

ASTM D523-85 E1, *Standard test method for specular gloss*¹⁾

ASTM D1654-79A, *Method for evaluation of painted or coated specimens subjected to corrosive environments*¹⁾

ASTM D2794-84, *Standard test method for resistance of organic coatings to the effects of rapid deformation (impact)*¹⁾

ASTM D3359-83, *Standard methods for measuring adhesion by tape test*¹⁾

ASTM D4060-84, *Standard test method for abrasion resistance of organic coatings by the Taber abraser*¹⁾

ASTM D4585-86A, *Standard practice for testing water resistance of coatings using controlled corrosion*¹⁾

ASTM G53-84, *Standard recommended practice for operating light- and water-exposure apparatus (fluorescent UV-condensation type) for exposure of nonmetallic materials*¹⁾

3. Definitions

3.1 routine tests: Tests made for quality control by the manufacturer on every device or representative samples, or on parts or materials as required to verify during production that the product meets the design specifications and applicable standards.

NOTES:

1 — Certain quality assurance tests on identified critical parts of repetitive high-production devices may be tested on a planned statistical sampling basis.

2 — Routine tests are sometimes called production tests.

3.2 design tests: Tests made by the manufacturer to determine the adequacy of the design of a particular type, style, or model of equipment or its component parts to meet its assigned ratings and to operate satisfactorily under normal service conditions or under special conditions if specified. These tests may be used to demonstrate compliance with applicable standards of the industry.

NOTE — Design tests, sometimes called type tests, are made on representative apparatus or prototypes to verify the validity of design analysis and calculation methods and to substantiate the ratings assigned to all other apparatus of basically the same design. These tests may also be used to evaluate the modification of a previous design and to ensure that performance has not been adversely affected. Test data from previous similar designs may be used for current designs where appropriate. Once made, the tests need not be repeated unless the design is changed so as to modify performance.

3.3 conformance tests: Performance tests that are conducted to demonstrate compliance with the applicable standards. The test specimen is normally subject to all planned routine tests prior to initiation of the conformance test program.

NOTE — The conformance tests may or may not be similar to certain design tests. Demonstration of margins (capabilities) beyond the standard requirements is unnecessary.

¹⁾Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

3.4 pad-mounted enclosure: An enclosure containing electrical apparatus typically located outdoors at ground level where the general public has direct contact with the exterior surfaces of the equipment. The general construction of this equipment shall be such that authorized personnel may obtain access to the apparatus inside the equipment compartment.

3.5 enclosure security: The completely assembled apparatus will resist unauthorized entry when tested according to the procedures of this standard.

3.6 axial force: A force applied along the axis of the pry bar from its handle to its pry tip.

3.7 prying leverage: A force at right angles to the handle times the distance from this force to the point of insertion of the pry tip into a joint, crevice, etc., of the enclosure.

3.8 dry thickness: Thickness of any applied coatings measured after curing.

3.9 coastal environment: The land area within 2500 feet of the mean high water line.

3.10 substrate: The material that provides structural integrity to the enclosure.

3.11 gel coat: The material that provides the inhibition for ultraviolet protection and color to the fiber reinforced plastic (FRP).

3.12 above grade: A term that refers to equipment intended for use above the high water line and not intended for partial or total submersion.

4. Enclosure security

(Refer to clause 4. of ANSI C57.12.28-1988)

This clause is intended to comply with clause 4. of ANSI C57.12.28-1988 in its entirety, including text, tables, and figures.

5. Enclosure corrosion resistance and coating system requirements

5.1 Enclosure design requirements – Objective

The objective of this subclause is to describe the corrosion resistance requirements of pad-mounted enclosure systems for coastal environments. Other performance requirements may be needed to provide long field life in other environments.

5.1.1 Contaminated accumulation

The enclosure shall be designed to shed water and minimize areas where corrosive elements can accumulate.

5.1.2 Weld-surface preparation

All welds shall be treated to prepare the weld area and the heat-affected zones for coating. Weld spatter shall be removed prior to coating. All welds are to be made in accordance with appropriate industrial welding standards.

5.1.3 Shipment

The manufacturer shall provide a method of shipment that will allow the enclosure to be received by the purchaser such that it still meets the performance tests required by this standard.

5.2 Substrata requirements

5.2.1 General

The substrata shall be of a material that, when coated or otherwise processed, will maintain the structural integrity of the enclosure over the life of the apparatus.

5.2.2 Specification of substrata characteristics

The apparatus enclosure substrata shall exhibit a general corrosion rate not to exceed 1 mil (.001) per year and a maximum pit depth not to exceed 5 mil (.005), over the life of the apparatus, when exposed to natural corrosive environments.

5.2.3 Substrata performance requirements

Five (5) uncoated, welded substrata specimen test panels and five (5) AISI 409 stainless steel, unwelded, control test panels, when exposed to 1500 hours of salt spray in accordance with ASTM B117, shall be evaluated for percent weight loss. The average weight loss of each set of test panels shall not exceed 2.5% after the 1500 hours exposure. In addition, the ratio of the average percent weight loss between the specimen test panel and the control test panel sets shall not exceed 5 to 1. (It is not uncommon for the welded specimen test panel to exhibit greater weight loss due to the galvanic action between the weldment and the base metal.)

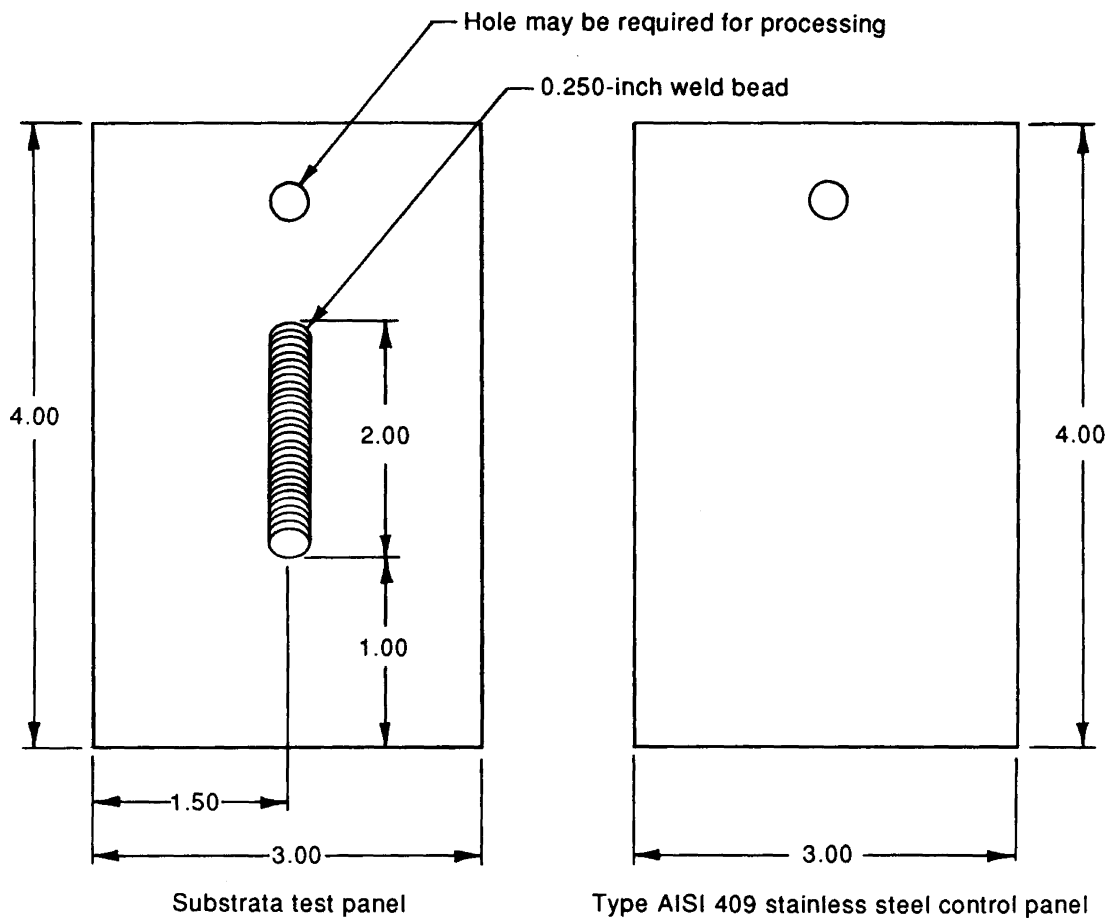
The welded test panel shall be fabricated in accordance with figure 1 using standard production welding, fabrication, and cleaning practices. The AISI 409 control test panel shall be unwelded but fabricated and pretreated using standard production practices prior to testing.

See annex A for the procedure for comparative weight loss analysis of the test panels.

5.3 Coating system requirements

5.3.1 General

All coated or gel-coated surfaces on the exterior or interior of the enclosure that may be exposed to the atmosphere shall be capable of meeting the performance tests required by this standard.



NOTES

- 1 Thinnest gage used in final product.
- 2 Weld rod as utilized in production
- 3 Both panels are to be cleaned and uncoated.

Figure 1— Panels for substrata evaluation

5.3.2 Specification of coating characteristics

If more than one coating system is used for different areas of the enclosure, the areas in which each is used shall be identified. For each coating system, the method of surface preparation, the method of coating, the minimum dry thickness and curing cycle of each coating, the minimum dry thickness of the total coating system, and the laboratory test performance data of the total coating system shall be submitted for approval upon request. This data shall be resubmitted whenever there are changes in the method and materials or both. It shall be the responsibility of the purchaser to perform any additional testing not required by this standard.

5.3.3 Enclosure color

Unless otherwise specified, the topcoat color shall be Munsell 7GY 3.29/1.5 pad-mount green.

5.3.4 Coating touch-up prior to shipment

Touch-up, when required, shall be done on final inspection before any equipment is shipped. In areas where the integrity of the coating system is violated, the touch-up system shall blend smoothly and meet all performance criteria of the original coating system.

5.3.5 Coating maintenance procedure

A coating system maintenance procedure shall be recommended by the manufacturer.

5.4 Coating system test specimens

5.4.1 General

Test specimens shall consist of panels of the same material, lightest gauge metal, or thickness of the fiber reinforced plastic (FRP) used in production. The test panel for salt spray shall be fabricated in accordance with figure 2. All panels shall be fabricated, cleaned, coated, and cured using the production systems. Panels representative of the touch-up systems shall pass all original performance criteria.

5.5 Coating system performance requirements

5.5.1 Salt spray test

For coatings on the interior and exterior of the enclosure, scribe a panel to the substrate and test for 1500 hours in accordance with ASTM B117.

The panel shall be scribed in accordance with ASTM D1654. Loss of adhesion shall be determined by procedure *A* set forth in 7.2 of ASTM D1654.79A.

Loss of adhesion from the substrate shall not extend more than 1/8 inch from the scribe at any point along the scribe.

The unscribed portion of the test panel shall be evaluated using procedure *B* as specified in ASTM D1654.79A. There shall be no corrosion spots or blistering.

5.5.2 Crosshatch adhesion test

Scribe a panel to the substrate with a crosshatch pattern and test in accordance with ASTM D3359. Method *A* shall be used for films thicker than 5 mils, and Method *B* shall be used for films less than or equal to 5 mils. There shall be 100% adhesion to the substrate and between layers.

5.5.3 Condensing humidity test

Test a panel for 1000 hours in accordance with ASTM D4585 except at $45^{\circ}\text{C} \pm 1^{\circ}\text{C}$. There shall be no blisters. Coating shall not-soften. Hardness is to be determined as shown in ASTM D3363.

5.5.4 Impact test

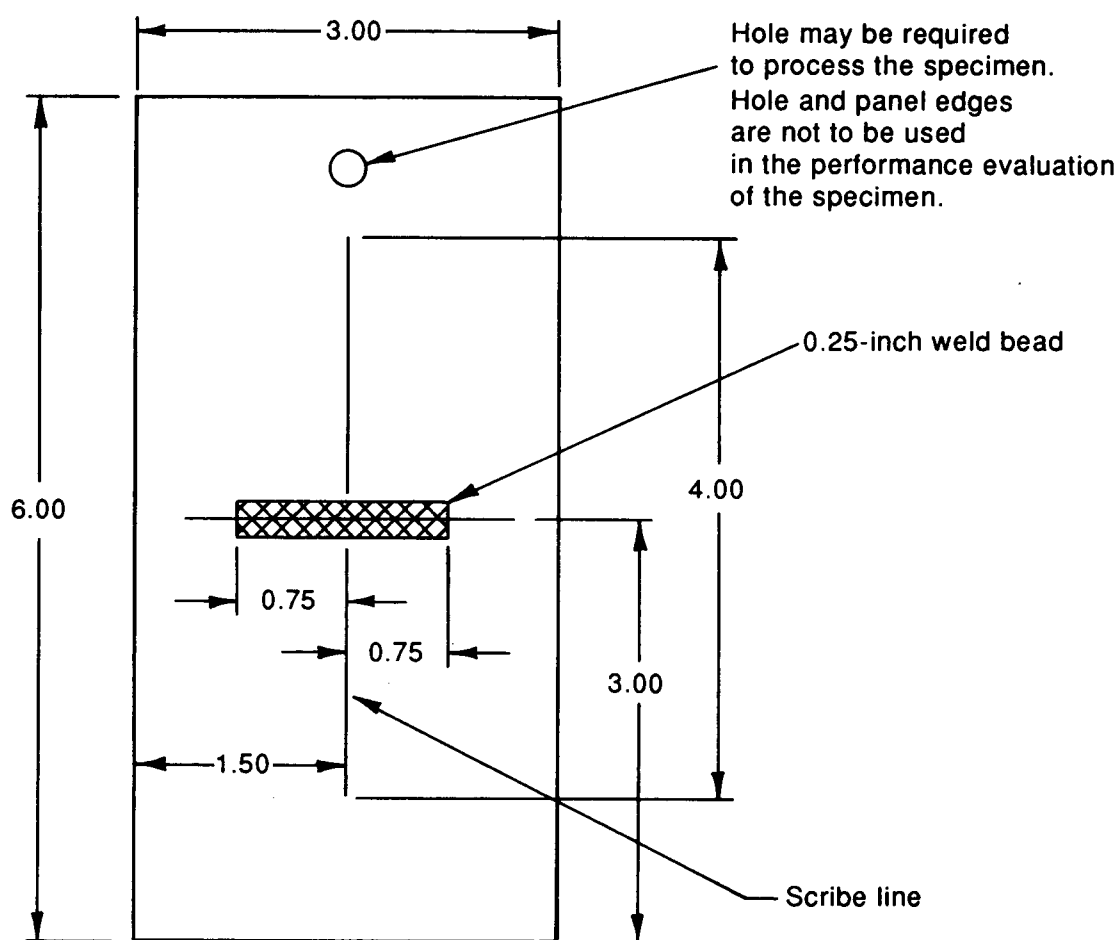
A test panel shall be impacted using procedures specified in ASTM D2794 at a value of 160 inch-pounds. There shall be no chipping of the paint on the impact (intrusion) side of the test panel.

5.5.5 Oil resistance test

Partially immerse two test panels in the liquid used as the insulating medium for 72 hours, one at room temperature, 20° to 25°C, and one at 100°C to 105°C. There shall be no color shift, blisters, loss of hardness, or streaking, when compared to the unimmersed portion of the test panel.

5.5.6 Ultraviolet accelerated weathering test

The following test is required only for coated surfaces on the exterior of the enclosure. Expose a test panel for 500 hours in accordance with ASTM G53, utilizing the FS-40 bulb with a cycle of 4 hours ultraviolet at 55°C followed by 4-hours condensation at 40°C. Loss of gloss shall not exceed 50% of original gloss in accordance with ASTM D523. In addition, the coating shall not exhibit cracking or crazing under unaided visual inspection.



NOTE – Hole in panel shall be oriented in the downward position for the salt spray test.

Figure 2— Test panel

5.5.7 Abrasion resistance - Taber abraser test

Test panel having the minimum dry thickness ($-0, +0.1$ mil) of the total coating system using a CS-10 wheel, 1000 gram weight, in accordance with ASTM D4060. The number of cycles of abrasion required to wear the coating through to the substrate or structural glass (for FRP) shall be at least 3000 cycles.

6. Labels

(Refer to clause 6. of ANSI C57.12.28-1988)

This clause is intended to comply with clause 6. of ANSI C57.12.28-1988 in its entirety.

**Annex A Procedure for comparative weight loss on welded and non-welded
unpainted stainless steel
(Informative)**

- a) Inspect welded panels to assure that welds are smooth and will not collect salt in any area when exposed in accordance with ASTM B117 with the major axis of the weld upright;
- b) Ensure that all test panels are thoroughly dry. Record the weight of each panel to the nearest 0.0001 gram;
- c) Expose all test panels to 1500 hours salt spray in accordance with ASTM B117;
- d) After exposure, immediately remove the test specimen and immerse in warm water;
- e) Manually scour each panel while wet using a nonmetallic, abrasive pad such as Scotchbrite #86 heavy-duty pads or equivalent. Remove rust from pits with a sharp tool;
- f) After scouring all panels, rinse in clean warm water (never let the panels dry until rinsing is complete).
- g) Ensure the test panels are thoroughly dry;
- h) Reweigh the panels to the nearest 0.0001 gram and calculate the percent weight loss.

Annex B Bibliography

(Informative)

ANSI C2-1990, *National electrical safety code*

ANSI C57.12.20-1988 through C57.12.39, *Pole, pad, and submersible transformer standards*

ANSI/IEEE C42.100-1984, *Standard dictionary of electrical and electronics terminology*